PALEONTOLOGY

Project title:	**Depositional Micro-Environments and Preservation Potential of Plants and Arthropods in Recent and Fossil Hot Spring Systems**
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Objective: Recent discoveries of exceptionally preserved early terrestrial plants and animals from the Early Devonian (400 Ma old) Rhynie chert hot spring complex (Aberdeenshire, Scotland, UK) has revealed the potential for exceptional fossilization (including soft tissues) within hot spring systems. The Rhynie complex consists of at least two separate vents, one of which exhibits geyserite splash texture. The current project extends the scope of the study to include recent silica-depositing systems within Yellowstone National Park as analogs for this fossil example. Collections of silica encrusted and silica entombed arthropods (primarily insects) will be examined alongside pre-existing water chemistry data and the geometry and topography of the hosting geothermal features to reveal processes involved in the entrapment and fossilization of organic debris.

Findings: Initial fieldwork during late August 1999 revealed the presence of three geothermal features capable of preserving organic remains: Medusa Spring, Opalescent Spring, and Porkchop Geyser, all within the bounds of the Norris Geyser Basin. The three systems varied markedly in water chemistry, topography, activity, and outflow geometries, revealing complexity behind fossil preservation in hot spring systems. Silicified arthropods collected were dominated by dragonflies and moths. Ground dwelling fauna were represented by crickets and rare arachnids. Preservation often took the form of irregular siliceous concretions or "biscuits" with an organic nucleus formed due to repeated immersion of the object in silica-laden waters.

Project title: **Dendrochronology in the Yellowstone Fossil Forest**

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Objective: Map petrified wood localities and interpret ecological and depositional histories of various fossil forests using: 1) annual growth ring series (cross-identification, standard descriptive statistics, tree age determinations); 2) taxonomy; 3) taphonomy; and 4) rock descriptions. Most recently, attempts have been made to use botanical features from specific horizons at the Specimen Creek locality to determine stratigraphically equivalent horizons at an exposure 1.3 km to the southeast.

Findings: Fieldwork was conducted at the Specimen Creek 2B exposure on September 26 and 27. Data were collected from 24 stumps. No specimens were collected. Poor weather limited work time.

Project title: **Silicification of Higher Plants in Hot Spring Environments**

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Objective: 1) Assess the possible environments of higher plant silicification, burial, and diagenetic alteration associated with surface geothermal activity. 2) Investigate the extent and nature of silica mineralization within plant material of hot spring environments. 3) Determine physicochemical, biochemical, and physiological controls on silica permineralization at cellular to structural levels. 4) Compare silica fabrics from Yellowstone plants, sub-fossils, and fossils with those of a 400 million-year-old fossil hot spring deposit at Rhynie, Aberdeenshire, Scotland. 5) Investigate the physiological adaptations of modem plants to the sedimentary, hydrogeological, and geochemical regimes of modern hot springs and assess the probability of similar adaptive strategies in early terrestrial ecosystems. 6) Assess using in vivo and in vitro experimentation rates and sequences of silica mineralization within plants and plant organs commonly found in Yellowstone sub-fossil sinters.

Findings: 1) SEM observation of plant material displaying incipient silica mineralization provides evidence of intracellular nucleation, polymerisation, and aggregation of sub-micron spheres via colloidal

mechanisms. Infilling of intercellular voids occurs rapidly. Rigid silica-particle frameworks form during the first 12 months of immersion. 2) Silica deposition fabrics and the degradation of plant materials are mediated by the interplay between a suite of physicochemical parameters (notably pH, temperature, cation concentration) and microbial decomposition. Reduction or cessation of fungal activity by hot fluids promote exceptional preservation. 3) Rapid vertical, lateral, and temporal variation in substrate/groundwater temperature, moisture, and geochemistry indicate a degree of tolerance to those conditions in colonizing plants. Plant dissemules, xerophytes, halophytes, and aquatics occupy and are silicified within definable hot spring sedimentary facies.

Project title:	**Paleontological Survey of Yellowstone National Park**
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Objective: To develop a database of the fossil resources within Yellowstone National Park.

Findings: A significant amount of preliminary work has been accomplished. Vince Santucci has already published on the Internet (*http://www2.nature.nps.gov/grd/geology/paleo/yell_survey/index.htm*) our current knowledge about the paleontology of Yellowstone National Park. A manuscript on Eocene mammals from Yellowstone is in progress.